

ELECTRICAL PHENOMENA IN THE UPPER ATMOSPHERE.

By S. CHAPMAN.

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The electrical phenomena discussed in the paper are those arising in regions of the atmosphere at altitudes probably greater than 30 kilometers, as distinct from the ordinarily investigated phenomena of atmospheric electricity, which are confined to the troposphere and lower parts of the stratosphere.

Electrical phenomena in the upper atmosphere make themselves evident in two ways—by the production of luminosity, as in the case of the aurora, and by the variations which they cause in the earth's magnetic field. Auroral phenomena result from the injection, into the earth's atmosphere, of corpuscular radiations from the sun, the effects being associated, in large part, with particular regions of the sun's surface, e. g., sun spots. The sharp lower boundary frequently associated with auroral displays suggests a definite degree of penetration for the rays; and, the definiteness and magnitude of this penetration is well in harmony with the assumption that the rays are α rays. The assumption is further borne out by considerations of the magnitudes of the deflections which the rays must suffer, on account of their motion in the earth's magnetic field, in order to account for a radius of the auroral zones as large as 20 degrees, which is the radius found by actual measurement, and which is considerably greater than could be accounted for on the assumption that the radiation was of the β ray type.

As regards magnetic phenomena, there is a direct part, arising from currents induced in the upper atmosphere, and an indirect part arising from the currents which these induce in the earth. The atmospheric currents are of two types—those associated with magnetically quiet days, and those productive of magnetic storms. The former result from the electromotive forces induced in the upper atmosphere, as a result of its motion in the earth's magnetic field, under atmospheric tidal action, and under the influence of temperature variations produced by the sun. The currents induced depend not merely upon the electromotive forces, but also upon the conductivity of the upper atmosphere itself. The latter is greater in the sun-lit portions than elsewhere, so that, superposed on the diurnal and seasonal variations which the tidal motion would produce, we have the changes arising from variations in the solar radiation received throughout the day and year. Considerations of the amount of ionization necessary to account for the effects, and of the degree of penetration which the radiation must have to enable it to escape from the sun's atmosphere, suggest that the radiation effective in this process is of the γ ray type.

Disturbances of the magnetic-storm type are attributed to effects arising from the penetration of the outer layers of our atmosphere by the α rays responsible for the aurora. The view is expressed that, as the α rays enter the atmosphere, they cause a depression of the air as a result of loss of their momentum, and that this depression is followed by an upward motion resulting from electrostatic repulsion after the air has become charged. The downward motion of the air accompanying the depression, and the subsequent upward motion, both taking place across the earth's lines of magnetic force, give rise to induced currents; and, it is assumed that the magnetic fields of these induced currents are those which

are found associated with so-called magnetic storms. The view adopted accounts for the reversal of the magnetic effect, which is found to take place soon after the commencement of a magnetic storm.—W. F. G. Swann.

CLOUDINESS IN THE UNITED STATES.¹

By Prof. R. DEC. WARD, Harvard University.

[Author's abstract.]

The available cloudiness charts include those of Teisserenc de Bort (1884), Greely (1891), Clark (1911), and Gläser (1912). Gläser has made the most complete study of the cloudiness and sunshine of the United States to date. A new chart of mean annual cloudiness is presented, based upon the latest and most complete data now available. These were prepared for the author by the U. S. Weather Bureau, and include observations through the year 1918. The new chart is broadly generalized, being designed to present the larger facts, and not to emphasize details. The distribution of mean annual cloudiness is described and explained, and the seasonal variations in cloudiness are considered. A series of curves is given showing the monthly amounts of cloudiness at groups of selected stations in various parts of the United States.

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THERMAL BELTS AND INVERSIONS OF TEMPERATURE IN THE NORTH CAROLINA MOUNTAIN REGION.¹

By H. J. COX.

[Author's abstract.]

Observations were made by the U. S. Weather Bureau in the North Carolina mountain region from 1912 to 1916, inclusive, in cooperation with the North Carolina State Board of Agriculture, with the hope that so-called "thermal belts" might be more clearly defined.

Stations were installed at 16 places in the mountain region, distributed geographically and under varying conditions of topography, on valley floor, slope, and summit, there being 66 stations in all.

Inversion of temperature was observed on an average of three nights out of four, and the tendency toward inversion was so strong that the average minimum for the four-year period was found to be much higher at the summits than on the valley floor, and even at one place where the slope had a vertical height of 1,760 feet, this was true. Frequently inversions of 15 to 20 degrees F. were observed. The greatest was 31 degrees F. on Brown Mountain November 13, 1913, for a difference of elevation of 1,000 feet.

Inversions were noted under both anticyclonic and cyclonic conditions, in the latter case the temperature rising much more rapidly at the summit than at the base as the storm approached, warm winds of the lower levels being shut off by obstructing mountains and the cold air in the coves and valleys lower down being retained.

On the longest individual slope, 1,760 feet, the center of the thermal belt was usually at a point 1,200 to 1,300 feet above the valley floor, while on all short slopes (less than 1,100 feet) leading up to knobs, the highest minima were observed on the knobs themselves on radiation nights.

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